Siluro-Devonian Fish Biostratigraphy of the Canadian Arctic Islands

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Though Silurian and Devonian vertebrates have been well studied in Spitsbergen and western Europe, where they have proved valuable in biostratigraphy, faunas of comparable age in the Canadian arctic have only recently been described. Attempts to use these faunas to date the Canadian strata in relation to the standard European successions have proved difficult as faunal ranges have been incompletely known; some vertebrates appear to have occurred earlier in the Canadian arctic than elsewhere, and European and Canadian faunas probably remained separate until the Early Devonian. More precise correlations can now be made due to recent work on some arctic faunas and revisions of those in Spitsbergen. A fauna from Prince of Wales and Somerset Islands is found to be Ludlovian and Pridolian in age and equivalent in part to the *Hemicyclaspis* zone of the Anglo-Welsh succession. A fauna from Prince of Wales and Cornwallis Islands shows similarities to the fauna of the Vogti horizon of the Ben Nevis Formation in Spitsbergen and the Crouchi zone of the Anglo-Welsh succession.

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INTRODUCTION

The presence of the remains of ostracoderms in rocks of Silurian and Devonian age has been of great significance in geological studies. Since their use (White, 1950; White and Toombs, 1948) as zonal indicators in the Lower Old Red Sandstone of the Anglo-Welsh borders, they have continued to be of great value in stratigraphy. In particular the pteraspidids have been one of the most useful groups of ostracoderms within the Lower Devonian. White (1950) used the faunal break indicated by replacement of the traquairaspidids to mark the boundary between the Downtonian and Dittonian stages in the Welsh borderlands, and the pteraspidid zonal scheme established for the Lower Devonian has provided correlation throughout Europe (Obruchev and Karatajute-Talimaa, 1967, 1968; Schmidt, 1959; White, 1956, 1960), and with Spitsbergen and eastern Canada (Dineley, 1967). Though the fauna from these areas has been well known for a number of years, and much work has been carried out on correlation of sequences, it is only recently that attention has been turned to the vertebrate faunas of equivalent age in the Canadian arctic. Consequently only tentative correlations have been made as yet between these faunas and the better known ones in Europe and Spitsbergen (Blieck and Heintz, 1979; Dineley and Loeffler, 1976).

Rich ostracoderm localities were found on Prince of Wales, Somerset and Cornwallis Islands in the Canadian arctic (Fig. 1) by the Geological Survey of Canada in 1955 (Thorsteinsson, 1958). Since then further localities have been discovered in the same areas, and in the Yukon and British Columbia. Some of this material has been described (Broad, 1973; Broad and Dineley, 1973; Denison, 1963, 1964; Dineley, 1964, 1968, 1976; Dineley and Loeffler, 1976; Elliott, 1983; Elliott and Dineley, 1983; Loeffler and Dineley, 1976; Loeffler and Jones, 1976, 1977). However, many of the faunas are still awaiting description. Correlation of these faunas with the standard

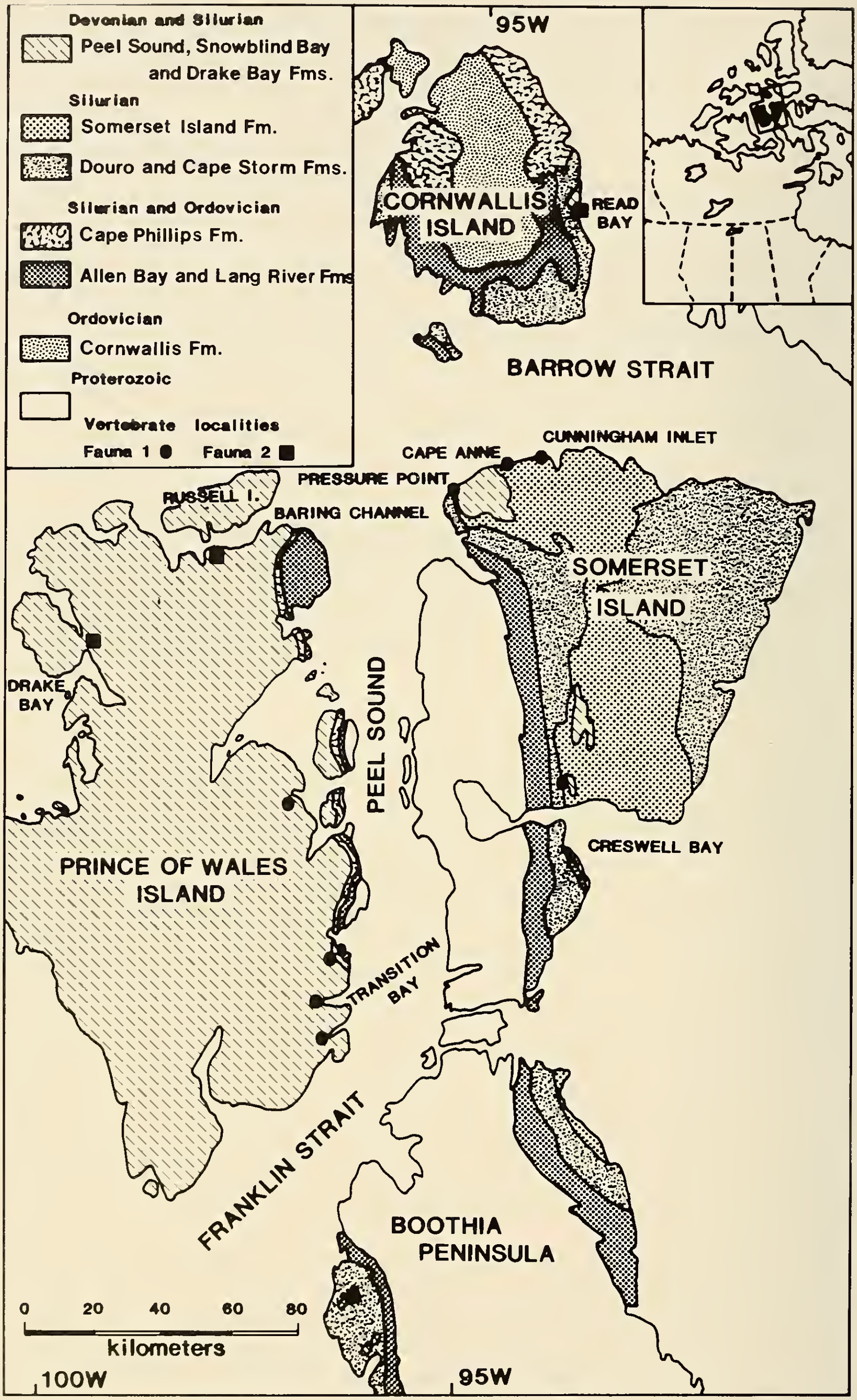

Fig. 1. Map showing collecting localities and geology of Prince of Wales, Somerset and Cornwallis Islands.

sequences developed in the Anglo-Welsh borders and in Spitsbergen has proved difficult for a number of reasons. It has been shown (Dineley and Loeffler, 1976) that heterostracan faunas in Europe and Canada remained essentially separate until the Early Devonian, when mixing was facilitated by the collision of the two continents. This faunal mixing is thought to have begun at the base of the Pococki zone, thus allowing the reliable use of ostracoderms for correlation of North American and European strata only after this date. Thelodonts have a wide geographical range at an earlier date, a feature attributed by Turner (1973) to a possible marine larval stage.

It also appears that a number of heterostracan groups occurred earlier in the Canadian arctic than elsewhere (Broad and Dineley, 1973). Thorsteinsson (1967) has reported anaspids, cyathaspidids and thelodonts from the Cape Phillips Formation, Cornwallis Island, in strata dated by graptolites as from late Llandoverian or early Wenlockian to early Ludlovian in age, and Broad (1973) has reported the earliest known amphiaspids from Pridolian strata on Ellesmere Island. In addition the ranges of the Canadian arctic faunas have been insufficiently known and hence correlations have been tentative. These factors have resulted in greater reliance being placed on the associated invertebrate faunas to date Silurian and Devonian strata in the Canadian arctic.

New descriptions of some of the fauna (Dineley, 1976; Elliott, 1983; Elliott and Dineley, 1983; Loeffler and Dineley, 1976; Vieth, 1980), together with new information on associated invertebrates (Thorsteinsson, 1980; Uyeno, 1980), and revisions of the Spitsbergen faunas (Blieck, 1982; Blieck and Heintz, 1979), have now made possible a more detailed correlation of some of the Canadian arctic faunas.

Stratigraphy

The faunas come from localities on Boothia Peninsula, and Somerset, Prince of Wales and Cornwallis Islands (Fig. 1), and occur in a thick sequence of Palaeozoic sediments flanking the Boothia Uplift (Kerr and Christie, 1965; Kerr and deVries, 1976). The uplift was caused by the Cornwallis Disturbance (Kerr, 1977), which had its greatest effect on local sedimentation during the Early Devonian. Continental clastic rocks were shed from the uplift during pulses of activity, but largely shallow marine carbonates were deposited when the influence of the uplift was slight. The lower Palaeozoic succession is thus characterized by a series of facies changes radiating from the Boothia Uplift. The succession (Fig. 2) was first described on Cornwallis Island (Thorsteinsson, 1958) where limestones and dolostones of Lower Ordovician to Silurian age are replaced northwards by graptolitic shales.

On Somerset and Prince of Wales Islands the first sequence that need concern us is the Douro Formation (this now replaces Read Bay Formation (Thorsteinsson, 1980)), a series of argillaceous limestones recently redefined by Miall and Kerr (1977). Jones and Dixon (1977) have shown it to be markedly diachronous across Somerset Island, ranging from Ludlovian in the west to Pridolian or younger in the east. On Somerset Island this formation is followed by the Somerset Island Formation (Miall, Kerr and Gibling, 1978). This formation is not found on Prince of Wales Island but is probably laterally equivalent to the lower member of the Peel Sound Formation there (Miall *et al.,* 1978). The formation consists of a lower member containing mottled limestones and dolostone, and red siltstone. The sediments were deposited in intertidal and supratidal environments in succession to the lagoonal and subtidal conditions prevailing in Read Bay times.

The succeeding Peel Sound Formation occurs over much of Prince of Wales Island, and in gentle synclines in the Cape Anne — Pressure Point and Creswell Bay areas of Somerset Island. On Somerset Island it has been redefined (Miall and Kerr,

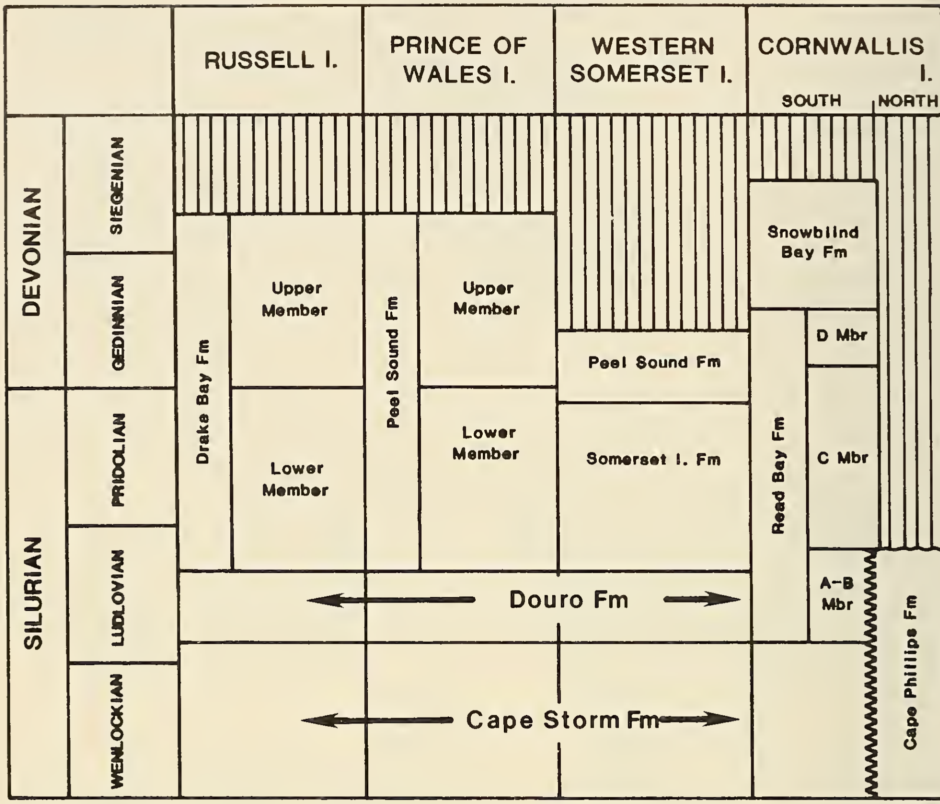

Fig. 2. Correlation of Silurian and Devonian strata in the central Canadian arctic.

1977) to take account of the new Somerset Island Formation, and consists of red sandstones and siltstones grading up into oligomict conglomerates and pebbly sandstones. On Prince of Wales Island the Douro Formation grades upwards into a similar succession, divided by Miall (1970) into a lower member consisting of interbedded limestones, siltstones, sandstones, and oligomict conglomerates, and an upper characterized by the disappearance of virtually all but conglomerate in the succession. Westwards it grades through five distinct facies outcropping as north-south bands. Conglomerate in the east is replaced laterally by conglomerate-sandstone, sandstone, sandstone-carbonate and carbonate facies (Broad, Dineley and Miall, 1968; Miall, 1970). The carbonate facies appears to be laterally equivalent to both members of the Peel Sound Formation nearer the uplift, and these sediments are now designated the Drake Bay Formation (Mayr, 1978).

On Cornwallis Island the Snowblind Bay Formation (Thorsteinsson and Fortier, 1954; Thorsteinsson, 1958) is a lateral equivalent of the Peel Sound Formation (Gibling and Narbonne, 1977). It rests conformably on the Sophia Lake Formation and consists of limestone breccia and conglomerate, siltstone and sandstone.

The Fauna of the Somerset Island Formation and the Lower Member of the Peel Sound Formation

This fauna is represented in scattered localities on Somerset and Prince of Wales Islands and Boothia Peninsula (Fig. 1, Fauna 1), but is most completely known from a ravine at Transition Bay on the east coast of Prince of Wales Island which cuts through vertical strata of the Douro and Peel Sound formations (Broad and Dineley, 1973). The vertebrates occur mainly in the sandstones and siltstones of the lower member of the Peel Sound Formation, where they consist of accumulations of disarticulated shields and plates, locally stacked and current aligned. The completeness of the section has allowed a tentative range chart to be produced (Fig. 3).

The fauna from this locality has already been dealt with in a number of publications. Broad has described the amphiaspids (1973), the traquairaspidids (1971), and with Dineley (1973) the cyathaspidid *Torpedaspis*. The pteraspidids have been described by Elliott (1984) and Elliott and Dineley (1983). A faunal replacement of *Traquairaspis* by *Protopteraspis* cannot be seen here as traquairaspidids are found throughout the section and occur with *Protopteraspis* towards the top. However a replacement of the Anchipteraspidinae by *Protopteraspis* can be seen, *Ulutitaspis truncata* and *U. notidana* characterizing the lower part of the section before replacement by *Protopteraspis sartokia* and *P. pygmaea*. *Boothiaspis* is particularly abundant at the base of the sequence but only one species, as yet undescribed, extends up into the section. *Corvaspis* occurs throughout almost the entire section as does *Torpedaspis* and *Poraspis;* however *Pionaspis* appears to be characteristic of the central part only.

This fauna is still incompletely known, as work on the traquairaspidids is still unpublished, and the cyathaspidids are still to be described. However the tentative ranges do provide a framework for local correlation. Localities to the north and south of Transition Bay and on the west coast of Boothia Peninsula have yielded *Protopteraspis pygmaea* (Fig. 1; locs 1,2,10,12 of Elliott and Dineley, 1983), indicating a position in the upper part of the lower member of the Peel Sound Formation. Further south on Prince of Wales Island (loc. 11 of Elliott and Dineley, 1983), the presence of *Protopteraspis siliktokia* with *Corvaspis* probably indicates a similar age.

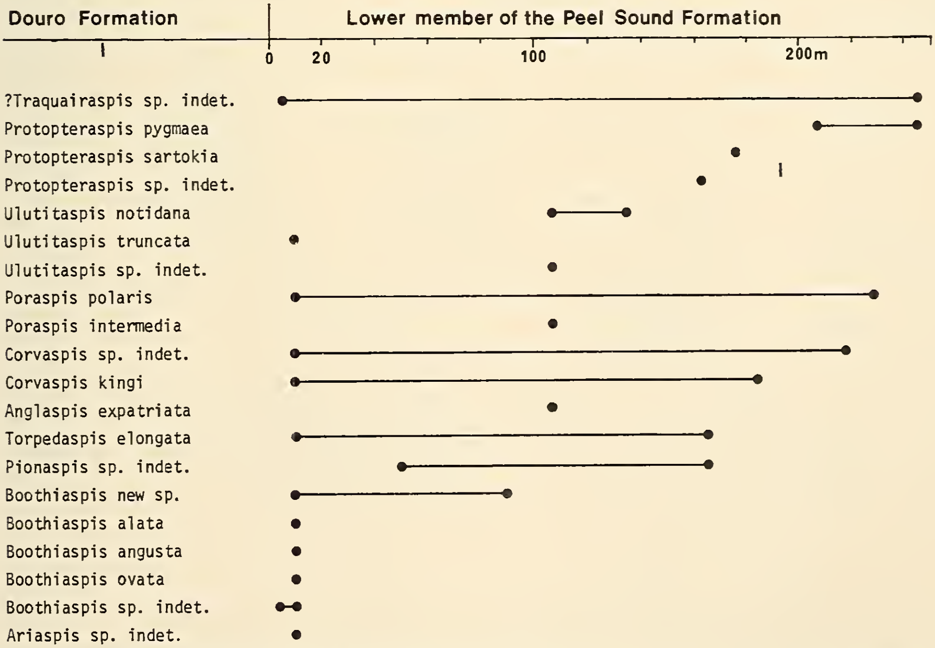

Fig. 3. Ranges of vertebrates in the lower member of the Peel Sound Formation at Transition Bay, Prince of Wales Island. (Some information from Broad and Dineley, 1973).

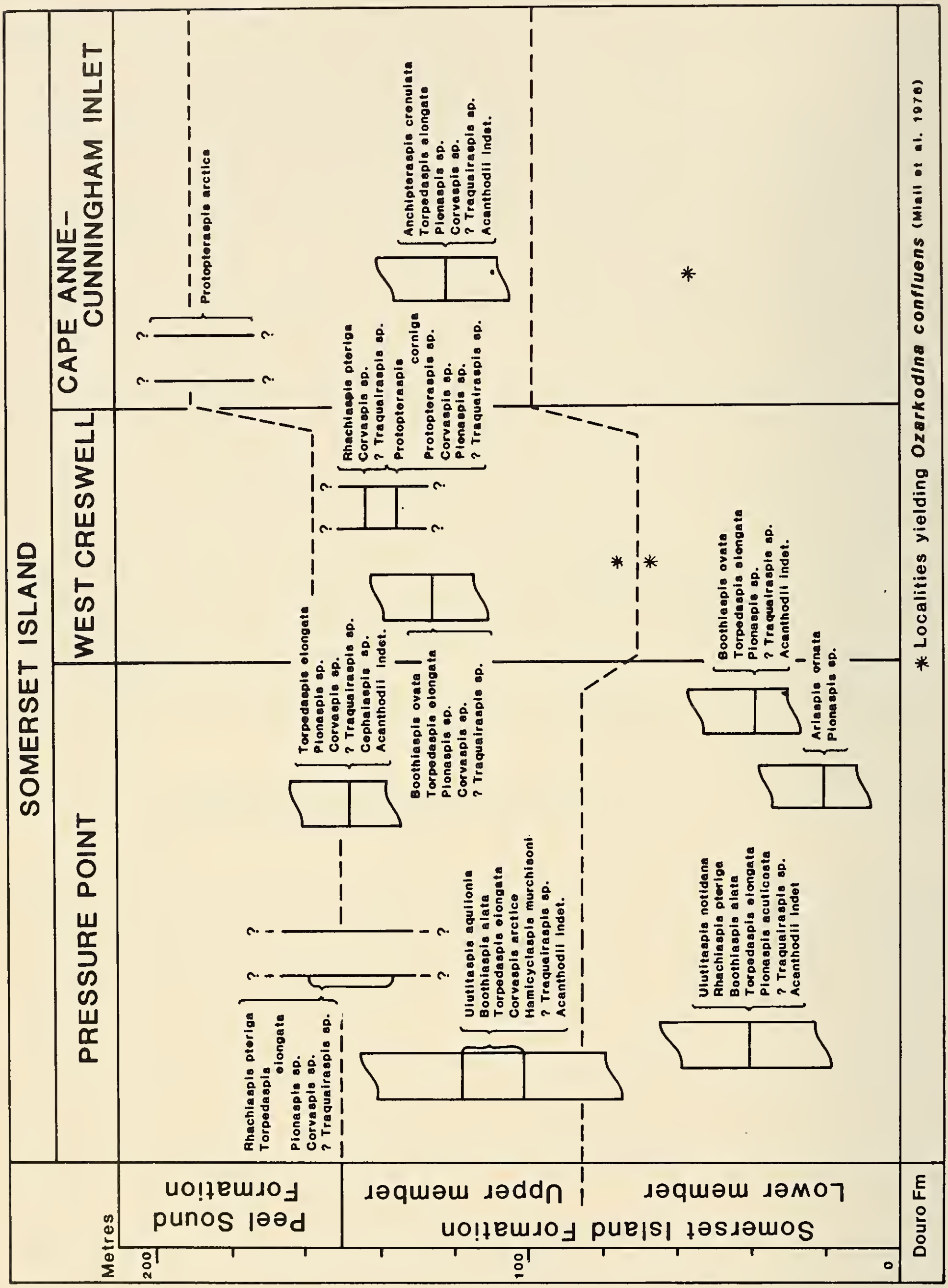

Fig. 4. Correlation of vertebrate horizons in the Somerset Island Formation, Somerset Island. (Some faunal and locality information from Broad, 1973; Broad and Dineley, 1973; Dineley, 1968; Gibling pers. comm.; Loeffler and Dineley, 1976).

To the east of the Boothia Uplift, on Somerset Island, no section through the Somerset Island Formation is as well known faunally as that at Transition Bay. However, a number of vertebrate horizons are sufficiently well known to enable some correlations to be made (Fig. 4). In the Pressure Point area a similar fauna is found, though no *Protopteraspis* is known from the upper part of the sequence. *Ulutitaspis* is again characteristic of the central part of the section, but is replaced in the upper part by *Rhachiaspis*. Several other forms have longer ranges here than on Prince of Wales Island. *Torpedaspis* and *Pionaspis* are present to the top of the formation, and *Boothiaspis alata* extends into the upper member, where it is associated with *Hemicyclaspis murchisoni*, one of the few vertebrates with stratigraphic significance beyond the Canadian arctic. Though *Protopteraspis* is not known at Pressure Point, it is found at Creswell Bay, where *P. corniga* occurs with *Rhachiaspis* in the upper member of the Somerset Island Formation. The exact stratigraphic horizon for this locality is not known, and neither is that for the locality yielding *Protopteraspis arctica* at Cape Anne on the north coast of Somerset Island. On lithological grounds however, both are probably at the top of the Somerset Island Formation.

Though the same species of *Protopteraspis* do not occur on both sides of the uplift, the faunas in the Somerset Island Formation and the lower member of the Peel Sound Formation are sufficiently similar to indicate their stratigraphic equivalence. Traquairaspidids, *Torpedaspis, Pionaspis, Ulutitaspis,* and *Corvaspis* have similar ranges in both, and *Protopteraspis* occurs in the upper part of both. *Boothiaspis* however appears to range higher in the Somerset Island Formation.

AGE OF THE FAUNA

The only truly diagnostic vertebrate in this fauna is *Hemicyclaspis murchisoni,* which occurs 15-18 metres above the base of the upper member of the Somerset Island Formation at Pressure Point. This is regarded as an index fossil for the lowest Downtonian of the Anglo-Welsh succession (White, 1950), now regarded as equivalent to the early Pridolian (Loeffler and Dineley, 1976). This occurrence was originally reported as being in the base of the Peel Sound Formation (Dineley, 1968), and Thorsteinsson (1980) has used this to suggest that the Somerset Island Formation is nowhere younger than late Ludlovian. However, redefinition of the base of the Peel Sound Formation (Miall and Kerr, 1977) would place this occurrence just above the base of the upper member of the Somerset Formation, thus indicating that the upper part of the formation could be younger than late Ludlovian in age. *Boothiaspis alata* occurs in both members of the Somerset Island Formation at Pressure Point, and also in the Devon Island Formation in southern Ellesmere Island. Here it is associated with a monograptid, dated as Pridolian on Cornwallis Island by Thorsteinsson (*in* Broad, 1973), where it occurs below *Monograptus transgrediens* Perner. *Ariaspis ornata,* which occurs in the lower member of the Somerset Island Formation at Pressure Point, has also been reported from Beaver River (Denison, 1963), and the Delorme Formation (Dineley and Loeffler, 1976). This heterostracan could indicate an age range of Wenlockian to Pridolian, as *Monograptus dubius* which occurs above the Beaver River fauna is known to extend from the Llandoverian to the Pridolian (Broad and Lenz, 1972). *Pionaspis acuticosta* which occurs with *Ariaspis ornata* at Pressure Point is otherwise known only from Muncho Lake, British Columbia, in strata considered to be late Downtonian on the presence of a traquairaspidid similar to *T. symondsi,* and a cyathaspidid held by Denison (1964) to be of this age. Dineley and Loeffler (1976) however, consider so precise a date debatable, considering the increase in knowledge of the range and diversity of these groups in the arctic.

Few diagnostic invertebrates are known from these horizons. However Miall *et al.*

(1978) have dated localities in the Somerset Island Formation at Cape Anne and Creswell Bay as Pridolian (Fig. 4), based on the presence of *Ozarkodina confluens* gamma morphotype, and *Pelekysgnathus* sp. Thorsteinsson (1980) considers the base of the formation to be latest Ludlovian (Latialata zone) on Boothia Peninsula, as *Pedavis* sp. aff. *P. thorsteinssoni* occurs there, and is associated with *Pedavis latialata* in the lower part of the Read Bay Formation on Cornwallis Island. On Prince of Wales Island, invertebrate dating of the lower member of the Peel Sound Formation has yielded Late Silurian ages (Bolton and Copeland, *in* Broad and Dineley, 1973; Bolton *pers. comm.,* 1976) for the whole of the sequence. Thorsteinsson (1980) concludes that the age range is late Ludlovian to early Pridolian based mainly on the presence of *Hemiarges bigener* towards the top of the lower member of the Peel Sound Formation. This trilobite is known from widely separate localities in the Canadian arctic, but wherever it can be related to diagnostic fossils it appears to be of Pridolian age (Thorsteinsson, 1980). On balance therefore it appears that both the lower member of the Peel Sound Formation and the Somerset Island Formation range from late Ludlovian to early Pridolian in age.

The Fauna of the Upper Member of the Peel Sound Formation and the Drake Bay and Snowblind Bay Formations

This fauna was originally described from the Baring Channel area on the north coast of Prince of Wales Island (Fig. 1), where it occurs in the sandstone-carbonate facies of the upper member of the Peel Sound Formation (Miall, 1970). Collecting at two levels has yielded a varied fauna, normally preserved as dissociated shields and plates, accumulated on bedding planes and showing current alignment, though some complete specimens are known. The arthrodire *Baringaspis dineleyi* Miles (1973) occurs in both horizons, while *Ctenaspis obruchevi* and *C. russelli* Dineley (1976) occurs in the upper and lower respectively. *Stegobranchiaspis baringensis* Elliott (1983) occurs at both horizons, as does a second, as yet undescribed, pteraspidid, and a third, *Escharaspis alata* Elliott (1983), is known from one specimen from the lower horizon. The upper member of the Peel Sound Formation was considered to be the age equivalent of the Snowblind Bay Formation on Cornwallis Island (Thorsteinsson and Tozer, *in* Fortier *et al.,* 1963), and a vertebrate fauna from the base of the formation at Read Bay supports this view. *Stegobranchiaspis baringensis* and the undescribed pteraspidid occur at this locality, and also found in common are *Anglaspis* sp., *Ctenaspis* sp. cf. *C. russelli,* ?*Weigeltaspis* (a primitive psammosteid), and a porolepid. In addition, the pteraspidid *Unarkaspis schultzei* Elliott (1983) occurs here, and suggests correlation with the upper part of the Drake Bay Formation on the east coast of Prince of Wales Island, which has also yielded the undescribed pteraspidid, the same *Anglaspis* sp., and a similar porolepid.

AGE OF THE FAUNA

No elements of this fauna are known from elsewhere in the Canadian arctic, although Vieth (1980) has reported the presence of *Turinia pagei, Gomphonchus sandalensis* and *Nostolepis* sp. at Baring Channel. They were associated with *Pelekysgnathus serratus serratus* (determined by O. H. Walliser; H. P. Schultze, *pers. comm.,* 1976), and other conodonts which closely resemble forms found in upper Lochkovian and lower to middle Pragian (upper Gedinnian-Siegenian) strata elsewhere in the Canadian arctic (Uyeno *in* Gibling and Narbonne, 1977). Thorsteinsson (1980) notes the presence of *Pedavis pesavis pesavis,* an index species of the latest Lochkovian conodont zone, with *Anglaspis* in the Drake Bay Formation. No dates are available for the base of the

Snowblind Bay Formation, but the greatest possible age for this fauna is indicated by a dating of early to possibly middle Lochkovian for the strata directly below it (Thorsteinsson, 1980). It therefore seems probable that this fauna is of late Lochkovian to early or middle Pragian (late Gedinnian to Siegenian) age.

Correlation with European Succession

White (1950, 1956, 1961) and Ball and Dineley (1961) used the heterostracans of the Anglo-Welsh borders to subdivide the Old Red Sandstone succession into the Downtonian, Dittonian and Breconian. Though there have been revisions of this scheme, particularly of the Downtonian-Dittonian boundary (Allen and Tarlo, 1963), the vertebrate succession of the Anglo-Welsh borders is still retained as a standard for correlation.

In Spitsbergen, vertebrates have been used to zone the Lower Devonian Fraenkelryggen and Ben Nevis Formations. Following the stratigraphic correlations of Friend (1961) and Ørvig (1969), the Fraenkelryggen is regarded as encompassing the Pococki and Leathensis zones of the Anglo-Welsh succession (White, 1950), spanning the uppermost Downtonian and lowermost Dittonian equivalents. Ørvig (1969) has shown that the Primaeva horizon of the Fraenkelryggen Formation can be correlated with the upper Symondsi or lowermost Leathensis zones of the Anglo-Welsh succession, while Blieck and Heintz (1979) have correlated the Anglaspis horizon with the upper part of the Leathensis zone, based on the presence of pteraspidids similar to *Protopteraspis leathensis.* In the Ben Nevis Formation the Vogti horizon has been correlated with the lower part of the Crouchi zone by Goujet and Blieck (1977). Though they felt that it showed many similarities with the Leathensis zone, the

SPITZBERGEN VOGTI HORIZON	PODOLIA CZORTKOV HORIZON	ARCTIC CANADA PEEL SOUND, DRAKE BAY, SNOWBLIND BAY FMS.
Protopteraspis vogti		Stegobranchiaspis baringensis
Miltaspis anatirostra	Althaspis (Loricopteraspis)	Escharaspis alata
Podolaspis goujeti	Podalaspis podolica	? Unarkaspis schultzei
	Traquairaspis sp. indet.	
Poraspis rostrata		
Homalaspidella nitida		
Irregulareaspis sp. indet.	Irregulareaspis stensioi	
Anglaspis sp. indet.		Anglaspis sp. indet.
Ctenaspis cancellata	Ctenaspis sp. indet.	Ctenaspis russelli
Ctenaspis sp. indet.		Ctenaspis obruchevi
		Ctenaspis sp. indet.
Corvaspis sp. indet.	Corvaspis sp. indet.	
Weigeltaspis heintzi		Weigeltaspis sp. indet.
Turinia pagei	Turinia pagei	Turinia pagei
Turinia oervigi	Turinia oervigi	Turinia polita
Apalolepis cf. obruchevi	Apalolepis obruchevi	
Gomphonchus cf. sandalensis		Gomphonchus sandalensis
Nostolepis striata	Nostolepis sp. indet.	Nostolepis striata
Nostolepis gracilis		
Lepidaspis sp. indet.		
Osteostraci common	Cephalaspis sp. indet.	Cephalaspis sp. indet.
	Placoderms	Baringaspis dinelevi

Fig. 5. Correlation of the faunas from the Vogti horizon, Spitsbergen, the Czortkov stage Podolia and the upper member of the Peel Sound. the Drake Bay and Snowblind Bay formations. (Some information from Blieck, 1982; Goujet and Blieck, 1977; Obruchev and Karatajute-Talimaa, 1967; Turner, 1973; Vieth, 1980).

presence of *Benneviaspis* and *Weigeltaspis,* which do not occur in Britain until later, led them to correlate it with the higher zone. The upper part of the Ben Nevis Formation may be equivalent to the upper part of the Crouchi and the Leachi zones, and the presence of *Althaspis*-like forms in both (Ball and Dineley, 1961; White, 1956, 1961) has been used as an argument in favour of this (Blieck and Heintz, 1979).

The lowest Canadian arctic fauna is dated as Ludlovian to Pridolian in age, chiefly on associated invertebrates. The only diagnostic vertebrate is *Hemicyclaspis murchisoni,* from the upper member of the Somerset Island Formation, which is also the index for the lowest zone of the Downtonian in the Anglo-Welsh succession. Few of the other arctic vertebrates can be correlated with those in Spitsbergen and western Europe. *Protopteraspis* and the traquairaspidids are the most diagnostic forms, but in Spitsbergen *Protopteraspis* does not occur until the Plant or possibly the upper part of the Corvaspis horizons (Blieck and Heintz, 1979) of the Fraenkelryggen Formation. Its appearance has been taken as a marker for the Downtonian-Dittonian boundary in the Anglo-Welsh borders. If applied to the arctic fauna, these correlations would be very much at variance both with the invertebrate dating, and with the presence of *Hemicyclaspis murchisoni.* It therefore seems probable that *Protopteraspis* occurs earlier in the Canadian arctic than it does elsewhere (Elliott and Dineley, 1983). The lowest faunal horizon in Spitsbergen, the Psammosteus horizon, does show some faunal similarity to the arctic fauna, as Blieck (*pers. comm.* 1982) has found a form that is probably a member of the Anchipteraspidinae, and *Corvaspis kingi* and traquairaspidids occur in both. It is possible therefore that the upper part of the arctic fauna may range as high as the Pococki zone, which has previously been correlated with the Psammosteus horizon (Fig. 6). However, the lower part of the fauna probably ranges down into the upper Ludlovian, and therefore has no faunal equivalent in Spitsbergen.

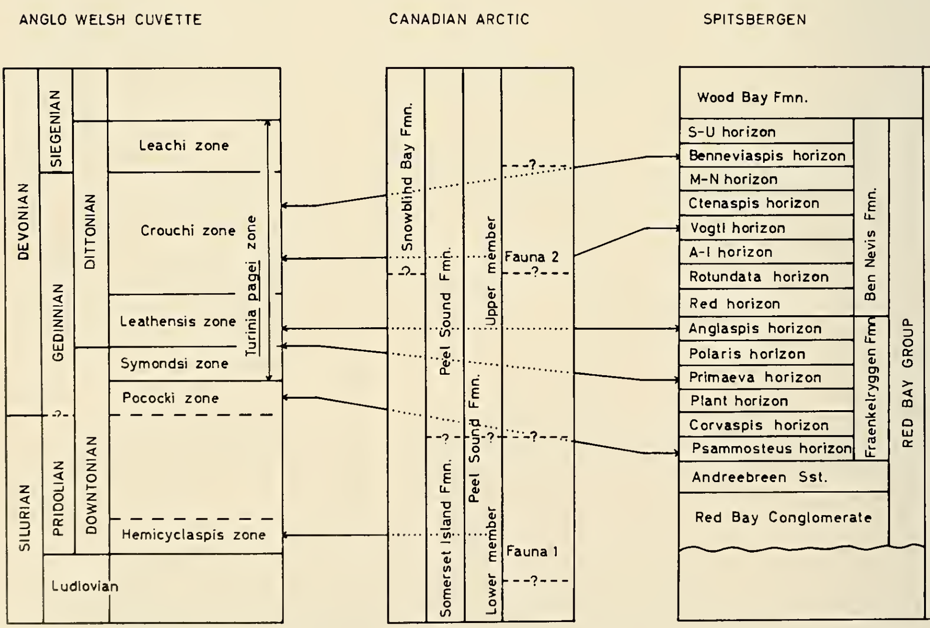

Fig. 6. Correlation of the Canadian arctic vertebrate horizons with the Anglo-Welsh and Spitsbergen successions.

The upper arctic fauna is dated as late Gedinnian to early Siegenian on associated invertebrates, which suggests that this horizon should be correlated somewhere within the Crouchi and Leachi zones of the Anglo-Welsh successions. Blieck and Heintz (1979) have suggested that the Vogti horizon of the Ben Nevis Formation is probably equivalent to the lower Crouchi zone, and the succeeding horizons could be equivalent to the upper Crouchi and Leachi zones.

Though the pteraspidids have been used as the most diagnostic members of the Spitsbergen fauna, and though the same forms do not occur in the Canadian arctic, comparison of the whole fauna does show a distinct similarity between the Vogti fauna and that from the arctic. Goujet and Blieck (1977) pointed out the comparable faunal associations between the Vogti horizon and the Czortkov stage in Podolia, citing the presence of similar pteraspidids of *Althaspis* and *Podolaspis* type, the cyathaspidids *Irregulareaspis* and *Ctenaspis,* and the thelodont *Apalolepis,* a genus considered to be characteristic of the Dittonian in Great Britain (Turner, 1973). Although the same pteraspidids are not present in the Canadian arctic, *Unarkaspis schultzei,* which shows a morphological similarity to *Podolaspis,* may indicate that a similar stage of development had been reached (Elliott, 1983). *Protopteraspis* is found only in Spitsbergen at this time; however *P. vogti* is the last member of this genus, and continued in this area after dying out in the Canadian arctic (Blieck, 1981; Elliott and Dineley, 1983). *Ctenaspis* occurs in all three horizons, and *Anglaspis* and *Weigeltaspis* occur in both the Vogti and Canadian arctic horizons. *Turinia pagei* is found in all three, as is also *Nostolepis*; and *Gomphonchus sandalensis* is common to the Canadian arctic and Vogti horizons. Differences are evident in the fact that *Baringaspis dineleyi* is present in the Canadian arctic fauna, while arthrodires are absent from the Vogti horizon (Goujet and Blieck, 1977; Blieck and Heintz, 1979). However, this may be due to differences in the environment of deposition. It appears possible, therefore, to draw an approximate correlation between the Canadian arctic fauna, that of the Vogti horizon in Spitsbergen, and the Crouchi zone of the Anglo-Welsh succession, already shown (Goujet and Blieck, 1977) to be equivalent in its lower part to the Vogti horizon. However elements of the same fauna extend upwards in the Spitsbergen succession. *Anglaspis* ranges up into the Benneviaspis horizon, as does *Ctenaspis,* and possibly *Miltaspis anatirostra* and *Podolaspis goujeti.* The correlation of this fauna is not clear therefore, and it may in part be correlative with the Leachi zone of the Anglo-Welsh succession, and the Benneviaspis horizon in Spitsbergen.

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